

ABSTRACT OF THE DISCLOSURE

In correcting the sound field, the loudspeakers 6_{FL} to 6_{WF} are sounded by the noise. The attenuation factors of the inter-band attenuators ATF_{11} to ATF_{ki} for adjusting gains of the band-pass filters BPF_{11} to BPF_{ki} to the frequency in respective channels are corrected based on detection results of the reproduced sounds of the loudspeakers 6_{FL} to 6_{WF} . Then, the attenuation factors of the channel-to-channel attenuators ATG_1 to ATG_5 are corrected based on the detection results of the reproduced sounds of the loudspeakers 6_{FL} to 6_{WF} . Then, the delay times of the delay circuits DLY_1 to DLY_5 are corrected based on the detection results of the reproduced sounds of the loudspeakers 6_{FL} to 6_{WF} . Then, the attenuation factor of the channel-to-channel attenuator ATG_k is corrected based on the detection result of the reproduced sound of the loudspeaker 6_{WF} as the subwoofer, whereby the levels of the reproduced sounds reproduced by the loudspeakers 6_{FL} to 6_{WF} are adjusted to be made flat over the audio frequency band.

FIG.1:

- (1) sound source 1
- (2) signal processing circuit 2
- (3) noise generator 3
- (4) D/A converter $4_{FL}, 4_{FR}, 4_C, 4_{RL}, 4_{RR}, 4_{WF}, 10$
- (5) amplifier $5_{FL}, 5_{FR}, 5_C, 5_{RL}, 5_{RR}, 5_{WF}, 9$
- (6) A/D converter 10

FIG.2:

- (1) noise generator 3
- (2) attenuator ATF_{11}, ATF_{12} to $ATF_{1j}, ATF_{k1}, ATF_{k2}, ATF_{ki},$
 $ATG_1, ATG_2, ATG_3, ATG_4, ATG_5, ATG_k$
- (3) delay circuit $DLY_1, DLY_2, DLY_3, DLY_4, DLY_5, DLY_k$

FIG.3:

- (1) frequency characteristic correcting portion 11
- (2) channel-to-channel level correcting portion 12
- (3) phase characteristic correcting portion 13
- (4) flatness correcting portion 14
- (5) system controller MPU

FIG.4:

- (1) middle/high frequency band processing portion (except subwoofer) 15a
- (2) low frequency band processing portion (except subwoofer) 15b
- (3) subwoofer low frequency band processing portion (only subwoofer) 15c

(4) calculating portion 15d

FIG.5:

- (1) logarithmic frequency (kHz)
- (2) gain (dB)
- (3) low frequency band
- (4) middle/high frequency band

FIG.6:

- (1) logarithmic frequency (kHz)
- (2) power (dB)
- (3) low frequency band
- (4) total power of loudspeakers 6_{FL} to 6_{WF}
- (5) power of loudspeakers 6_{FL} to 6_{RR}
- (6) power of a loudspeaker 6_{WF}

FIG.7:

- (1) front left-side loudspeaker 6_{FL}
- (2) center loudspeaker 6_C
- (3) front right-side loudspeaker 6_{FR}
- (4) rear left-side loudspeaker 6_{RL}
- (5) subwoofer 6_{WF}
- (6) rear right-side loudspeaker 6_{RR}

FIG.8:

- (1) start
- (2) frequency characteristic correcting process (S10)
- (3) channel-to-channel level correcting process (S20)
- (4) phase characteristic correcting process (S30)

(5) flatness correcting process (S40)

(6) end

FIG.9:

(1) start

(2) initialize the attenuators (S100)

(3) measure the sound field characteristic (S104)

(4) set a target curve (S106)

(5) calculate adjusted values $F_n(x, J)$ (S110)

(6) normalizing process (S120)

(7) calculate the attenuation factors SF_{xj} ,

adjust the attenuation factors of the inter-band
attenuators (S126)

(8) end

FIG.10

(1) start

(2) initialize the attenuators (S200)

(3) measure the sound field characteristic (S204)

(4) Have processes of the channels 1 to 5 been completed

$x=5$? (S208)

(5) set target data (S210)

(6) calculate adjusted values of the channel-to- channel
attenuators (S212)

(7) adjust the channel-to-channel attenuators (S214)

(8) return

FIG.11:

- (1) start
- (2) initialization (S300)
- (3) measure the sound field characteristic (S304)
- (4) Have processes of all channels been completed $x=k$?
(S308)
- (5) calculate delay times (S310)
- (6) calculate the average delay time (S316)
- (7) adjust the delay circuits (S318)
- (8) return

FIG.12:

- (1) start
- (2) set parameters (S400)
- (3) set target data (S402)
- (4) initialize the attenuator on the subwoofer channel
(S404)
- (5) measure the sound field characteristic (middle/high
frequency band of 5 channels) (S406)
- (6) measure the sound field characteristic (low frequency
band) (S408)
- (7) measure the sound field characteristic (only
subwoofer) (S410)
- (8) calculate the attenuator adjusted value on the
subwoofer channel (S412)
- (9) adjust the attenuator on the subwoofer channel (S414)
- (10) return